Space Weather Technical Forecast

Issued on Thursday, 01 August 2024 at 01:12 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

Space Weather Forecast Headline: M-flares expected, chance of X-flares. Potential further CME glancing blows Days 1-2 (01-02 Aug), risk of G1/Minor to G2/Moderate Storms. Chance of exceeding S1/Minor Radiation Storm threshold.

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity is Moderate to High, with seven M-class flares observed from across the disc, the strongest M7.7 peaking at 31/0646, likely from AR3768. We have a highly active disc with thirteen sunspot regions. AR3768 in the far southwest continues to display a delta spot to the north of one of its intermediates although this region is becoming increasingly difficult to assess near the limb. There is a cluster of spots in the southwest disc, with AR3765 and AR3767 in particular in very close proximity, to the point where the two regions are pushed together with the trailing and leading portions sharing a penumbra. AR3770 west of centre disc persists as a region with two very marked delta spots. AR3772 in the southeast is now also revealing a delta spot on one of its intermediate spots. The assessment of AR3774 near the southeast limb is still constrained by the viewing angle, so this classification may change. AR3775 and a new region in the northeast appear small and magnetically simple.
Currently none of the CMEs seen in imagery in the last 24 hours are thought to be Earth directed. A CME is likely to have been produced from AR3768's M5.4 flare peaking at 31/1837 UTC, but we await imagery to assess this. Given the region's location, it would need to be a particularly wide CME to affect Earth.

Solar Wind / Geomagnetic Activity: The solar wind, as measured by ACE at L1, has seen two further CME arrivals, one at 31/1040 UTC and the other at 31/1347 UTC. Wind speeds were mostly at slightly elevated levels, but with a slight uptick after each CME arrival, currently near 450 km/s. Density was well below average at first, but increased after each CME arrival, peaking briefly above average at 11ppcc. The Interplanetary Magnetic Field, Bt, was weak at first, increasing to moderate after the first CME arrival, then briefly becoming strong after the second arrival, peaking at 16nT. The north-south component, Bz, was weakly positive until the second CME arrival, after which it started to vary moderately, between +12/-13nT. Phi angle was positive (away from the Sun) at first, switching mostly negative (towards the Sun) after the second CME arrival. Geomagnetic activity was Quiet to Active (Kp1-4), with a G1/Minor Storm (Kp5) interval 31/1800-2100 UTC.

Energetic Particles / Solar Radiation: High energy (greater than 10 MeV) proton flux observed by GOES18 was at background levels throughout. High energy electron flux (greater than 2MeV) observed at GOES16 was also at background levels. The 24-hour fluence was below the Active threshold with 1.14e6 integrated pfu observed at 01/0000UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Moderate to High activity forecast to continue, with occasional M-class flares expected and a chance of isolated X-class flares.

Solar Wind /Geomagnetic Activity: Current CME influence is ongoing, but with limited impact so far. Further CME arrivals are then possible on Days 1-2 (01-02 Aug), chiefly on Day 1. They are

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both low confidence, but glancing blows are possible on both days. Furthermore, due to the number of coincident CMEs, further arrivals cannot be ruled out through the period.
No coronal hole fast wind enhancements are expected, with CME arrivals expected to be the main factor of interest during this period. Geomagnetic activity is expected to be often Unsettled to G1/Minor Storm, with a chance of G2/Moderate Storms and a slight chance of G3/Strong Storm intervals, should any CME arrivals bring more than a glancing blow. In the absence of further CME influence, activity is likely to become mostly Quiet to Unsettled later in the period.

Energetic Particles / Solar Radiation: High energy proton flux is currently at background levels. Should any notable flares occur in the western disk there is a chance of exceeding the S1/Minor Radiation Storm threshold. The high energy electron flux is forecast to be mostly at background levels, perhaps rising on Days 3-4 (03-04 Aug). The associated 24-hour fluence is likely to remain below the Active threshold (1e8 integrated pfu), with a slight chance of exceeding by the end of the period.

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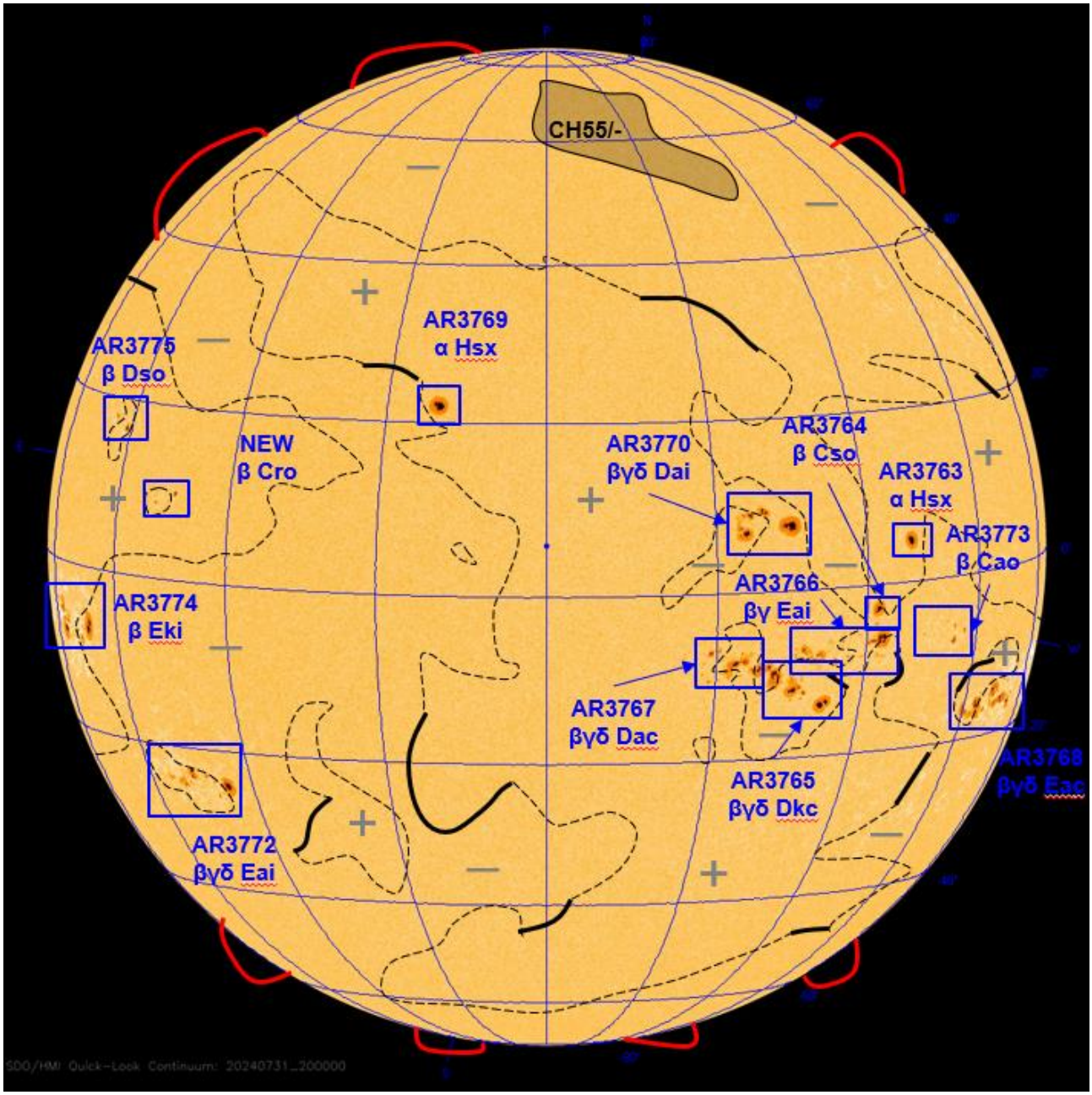
Figure 1. Solar Analysis Valid 31/2000 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

The CME influence from the arrival on 29 July has now eased, but two further CME arrivals during 31 July are keeping solar wind conditions slightly enhanced. These were likely from the M9.9 from AR3766 on 28/0200 UTC, and the combination of M2.6 at 28/1250UTC from AR3762 and the long duration M1.7 at 28/1422 UTC from AR3768.

Further CME arrivals are then possible on Days 1-2 (01-02 Aug), chiefly on Day 1 from the M8.7 flare at 29/1255 UTC from AR3762 and the dimming that occurred to the north of the region. This is low confidence, however with a glancing impact possible. The arrival on Day 2 is very low confidence, but the M9.5 at 30/1938 from AR3772 could give a glancing blow. Furthermore, due to the number of coincident CMEs, including those off the Earth-Sun line, analysis has been more difficult than usual. Consequently further arrivals cannot be ruled out through the period.

No coronal hole fast wind enhancements are expected, with CME arrivals expected to be the main factor of interest during this period. Geomagnetic activity is expected to be often Unsettled to G1/Minor Storm, with a chance of G2/Moderate Storms and a slight chance of G3/Strong Storm intervals, should any CME arrivals bring more than a glancing blow. In the absence of further CME influence, activity is likely to become mostly Quiet to Unsettled later in the period.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	Yes	60	20	5	5
Strong	G3	No	5	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
29/1832	Partial	AR3762	SW	700 km/s	01/1400 UTC +/-12 hrs	Low confidence. Glancing blow possible.
30/2230	Partial	AR3772	SE	1250 km/s	02/2100 UTC +/- 12hrs	Low confidence. Glancing blow possible.

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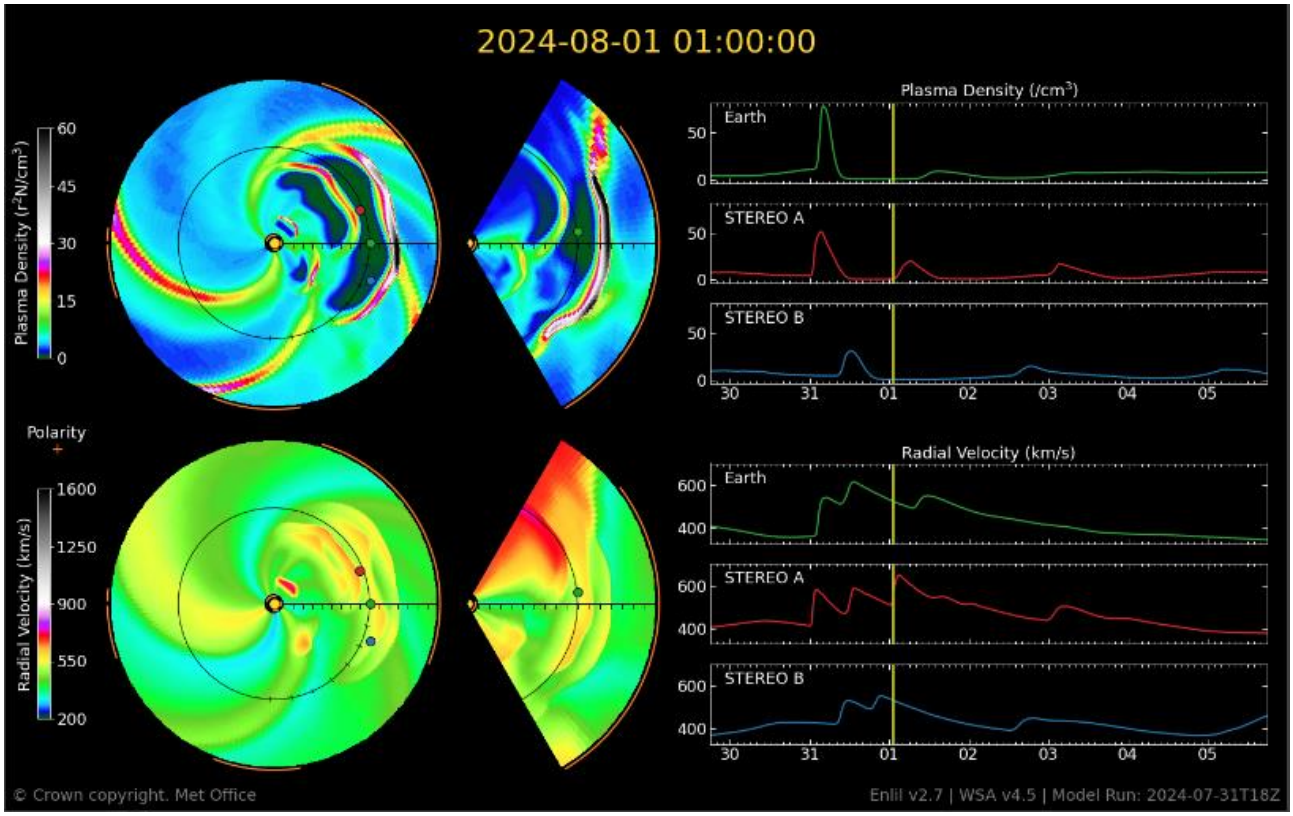
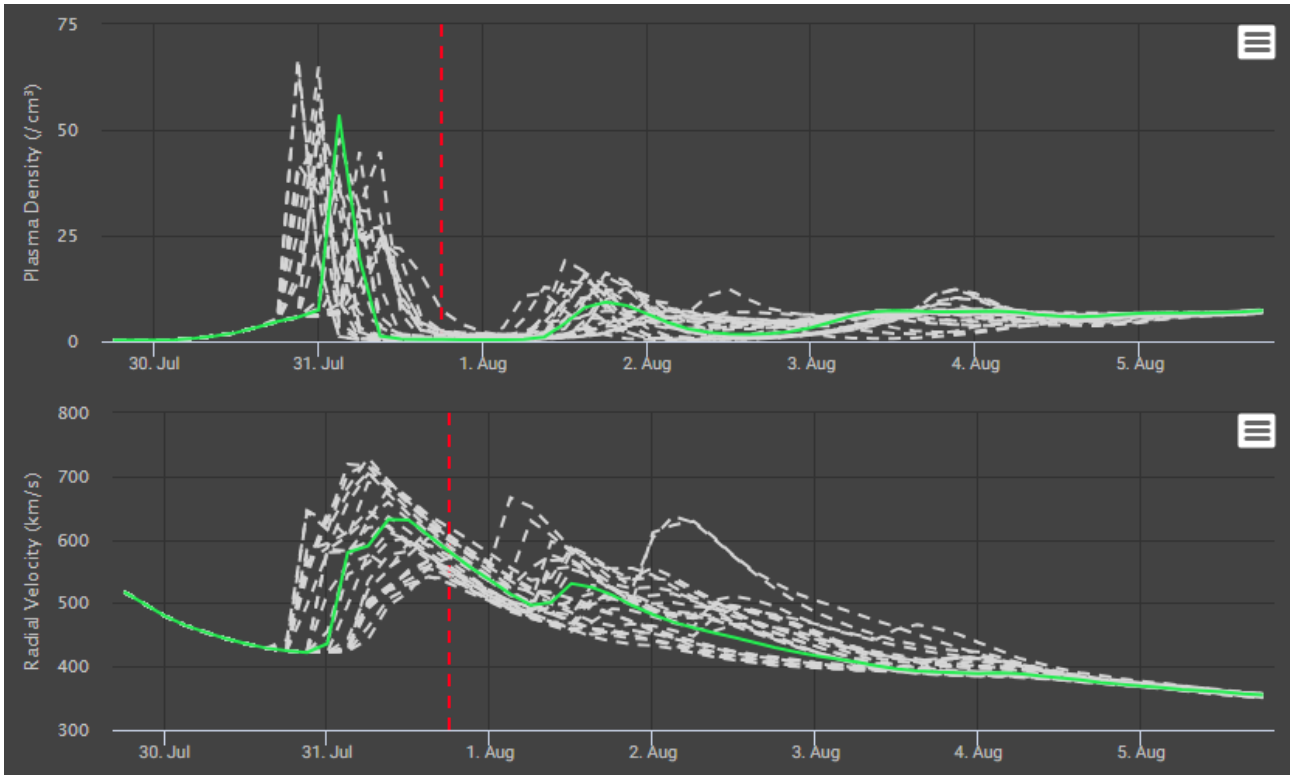
Figure 2: MOSWOC Enlil and ensemble, showing potential CME glancing blows in the next few days.





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Radio Blackouts - X-Ray Flares:

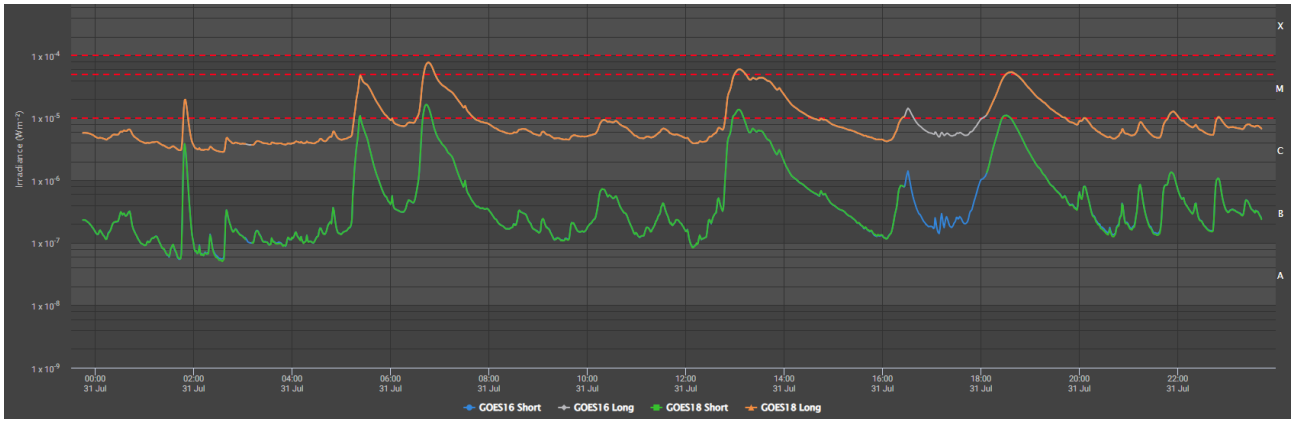
Solar activity is Moderate to High, with seven M-class flares observed from across the disc in the last 24 hours, the strongest M7.7 peaking at 31/0646, likely from AR3768. Moderate to High activity is forecast to continue, with occasional M-class flares expected and a chance of isolated X-class flares given the large number of complex active regions currently on the disk and activity over recent days.

A highly active disc with thirteen sunspot regions now that AR3762 is no longer visible on the west limb. AR3768 in the far southwest continues to display a delta spot to the north of one of its intermediates although this region is becoming increasingly difficult to assess near the limb. AR3765, AR3766 and AR3767 make up a cluster of spots in the southwest disc, with AR3765 and AR3767 in particular in very close proximity, to the point where the two regions are pushed together with the trailing and leading portions sharing a penumbra. AR3770 west of centre disc persists as a region with two very marked delta spots. AR3772 in the southeast is now also revealing a delta spot on one of its intermediate spots. The assessment of AR3774 near the southeast limb is still constrained by the viewing angle, so this classification may change. AR3775 and a new region in the northeast appear small and magnetically simple.

Far-side sounding data also suggests the potential for further large oncoming regions later in the period. A very slight drop in flare risk has been suggested for Day 4 (04 Aug), although oncoming regions could potentially balance the loss of AR3768 which rotates off the disc late on Day 2 (02 Aug), albeit the flare risk from this region remains until later on Day 3 (03 Aug).

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	90	90	90	80
Very Active	R3 to R5 X Class	No	25	25	25	20

Figure 3: X-ray flux at GOES16 and 18, with several M-class flares in the last 24 hours.



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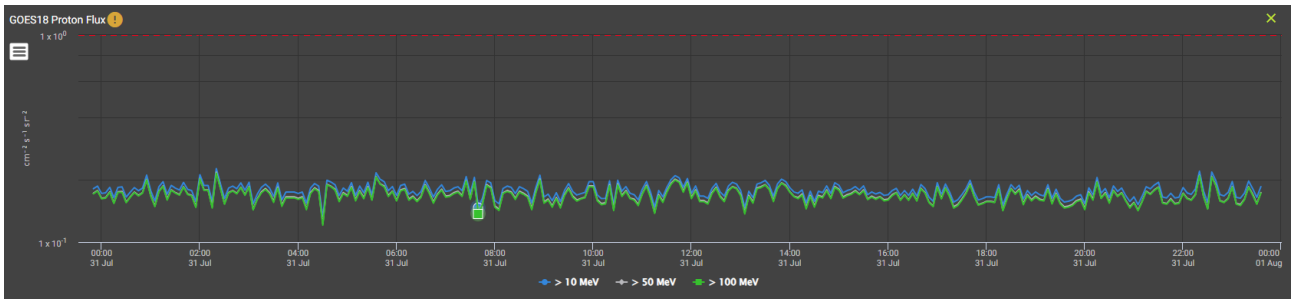
Solar Radiation Storms - (High Energy Protons):
High energy proton flux, as observed by GOES-18, is currently is currently at background levels but has the potential to rise in response to any notable flares on the disc, particularly those from the west of the disc. There are a number of moderately sized and complex sunspots in the western hemisphere and therefore in a favourable position to give proton enhancement given any significant flare activity. This brings a chance of reaching the S1/Minor Radiation Storm level throughout the period. Whilst AR3768 rotates off the disc late on Day 2 (02 Aug), the risk from this region will not reduce until it is several days over the west limb.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	≥ S1	No	25	25	25	25
Very Active	≥ S3 *	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Proton flux as measured at GOES18 is currently at background levels.



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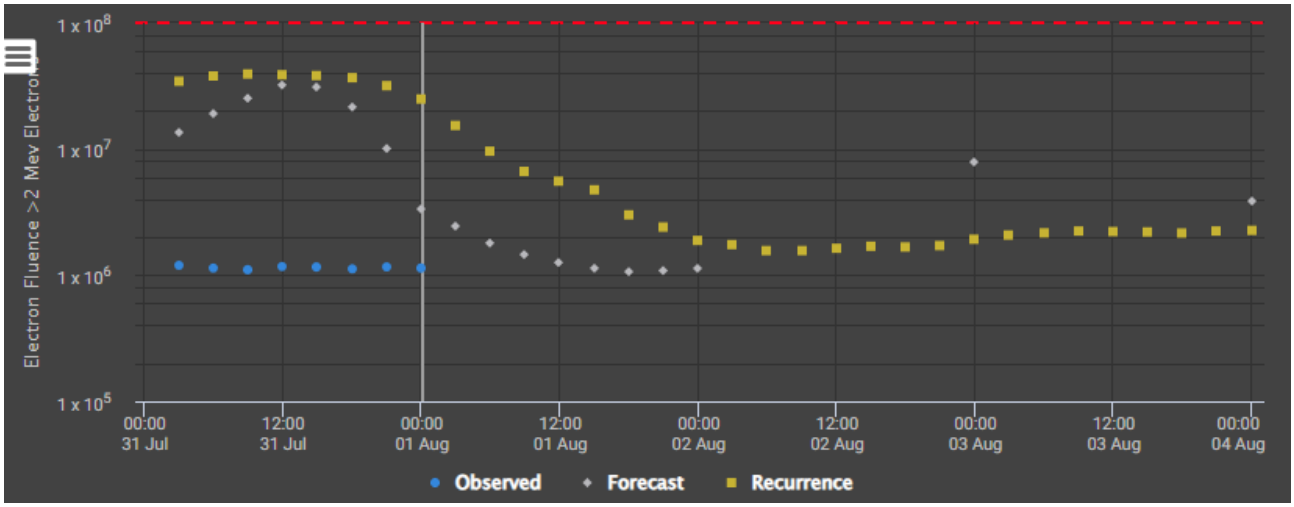
High Energy Electrons Event (≥ 2MeV):
High energy electron flux, as observed by GOES-16, is currently at background levels after being suppressed by the CME arrival late on 29 July. Further CME arrivals are likely to keep the observed flux near background levels in the short term, but recent CME activity may have caused an increase in electron flux below GEO. Assuming CME influence wanes later in the period (an assumption where confidence is low), this may allow for an increase in electron flux later in the period, with moderate or perhaps even high flux possible at the diurnal peak on Days 3-4 (03-04 Aug).

The associated 24hr electron fluence is likely to remain below Active (1e8 integrated pfu), although with the potential for a rising trend later in the period. There is a slight chance of exceeding Active by Day 4. MOSWOC REFM is currently suggesting below Active through the next three days, which is reasonable, but confidence becomes increasingly low given uncertainties in CME influence.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	1	5	15
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: MOSWOC REFM is showing a below Active trend through the next three days.



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